ATTORNEY DOCKET NO. LAM2P445

U.S. PATENT APPLICATION

FOR

APPARATUS AND METHOD FOR CONTROLLING FILM THICKNESS IN A CHEMICAL MECHANICAL PLANARIZATION SYSTEM

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CROSS REFERENCE TO RELATED APPLICATIONS

This application is continuation-in-part of U.S. Patent Application Serial No. 10/463,525, entitled "METHOD AND APPARATUS FOR APPLYING DIFFERENTIAL REMOVAL RATES TO A SURFACE OF A SUBSTRATE," filed on June 30, 2003 which is a continuation in part of U.S. Patent Application Serial No. 10/186,472, entitled "INTEGRATION OF EDDY CURRENT SENSOR BASED METROLOGY WITH SEMICONDUCTOR FABRICATION TOOLS," filed on June 28, 2002. The disclosure of these Patent Applications are incorporated herein by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The invention relates generally to semiconductor fabrication and more specifically to process control during chemical mechanical planarization (CMP) wafer processing.

2. Description of the Related Art

[0002] In the fabrication of semiconductor devices, there is a need to perform Chemical Mechanical Planarization (CMP) operations, including removal of the excessive material, buffing and post-CMP wafer cleaning and drying. Typically, integrated circuit devices are manufactured in the form of multi-level structures. At the substrate level, transistor devices having positively and negatively doped regions are formed. In subsequent levels,

interconnect metallization lines are patterned and electrically connected to the transistor devices to define the desired functional device. Patterned conductive features are insulated by dielectric materials, such as silicon dioxide. As more metallization levels and associated dielectric layers are formed, the need to planarize the dielectric material increases. Without planarization, fabrication of additional metallization layers becomes substantially impossible due to variations in the surface topography. In other applications, metallization line patterns are formed in the dielectric material, and then metal CMP operations are performed to remove excess metallization. Further applications include planarization of dielectric films deposited prior to the metallization process, such as dielectrics used for shallow trench isolation of for poly-metal insulation.

[0003] Typically CMP systems implement a rotary table, belt, orbital or brush operation in which belts, pads, or brushes are used to scrub, buff, and polish one or both sides of wafer. The pad itself is typically made of polyurethane material or other suitable material and may be backed by a rigid table, supporting belt, for example a stainless steel belt. In operation a slurry material is applied to and spread across the surface of the polishing pad or belt. As the belt or pad covered in slurry rotates, a wafer is lowered to the surface of the pad and is planarized.

[0004] The desired result of successful CMP operations is a uniform planar surface remaining on the processed wafer. Typically the removal rate of films on the wafer is carefully tracked or monitored. Various attempts have been made to control the operation of chemical mechanical planarization systems in order to provide uniform removal rates. One common attempt is to manipulate down force applied by the wafer carrier or other workpiece holding device, delivering variable pressure to an abrasive polishing surface. Unfortunately down force variation can lead to local degradation of so-called dishing and erosion performance at the sections of the wafer where high compensative down

force was applied. Excessive down force may cause other quality problems like film delamination, scratching, or inter-grain boundary damage. The focus on uniformity of removal rates is misguided for current applications. That is, from the end user's perspective, it is desired to have a uniform end layer on the surface of the semiconductor wafer which is not necessarily the result from a uniform removal rate. For example, if the surface of the wafer prior to planarization is not uniformly thick, the non-uniformities are maintained when a uniform removal rate is applied to the processed wafer. A uniform removal rate applied to substrate with greater edge thickness will result in a wafer with a lower center thickness, a condition similar to the wafer prior to the planarization application. Additionally, in the example related above, over-polishing of the center of the wafer can result in lost die and lower wafer yield.

[0005] During the CMP operation there are many opportunities for measuring device features on wafers. Many of the features can be determined by capturing a signal indicating the feature. As features continue to decrease in size, especially the thickness of films employed in the manufacture of semiconductors, the signals that are indicative of the feature become undetectable in certain situations. Inductive sensors may be used for displacement, proximity and film thickness measurements. The sensors rely on the induction of current in a sample by the fluctuating electromagnetic field of a test coil proximate to the object being measured. Fluctuating electromagnetic fields are created as a result of passing an alternating current through the coil. The fluctuating electromagnetic fields induce eddy currents which superimpose with the primary field and change the coils inductance. Feedback from sensors such as inductive sensors during planarization can allow for real-time monitoring and correction if needed during the CMP operation.

[0006] In view of the foregoing, there is a need to provide a method and apparatus that may deliver a uniform thickness rather than a uniform removal rate in order to provide

control over the uniformity of the targeted remaining layer thickness for the wafer.

SUMMARY OF THE INVENTION

[0007] Broadly speaking, the present invention is an apparatus that provides control over planarization resulting in a specified remaining film thickness on a semiconductor wafer. It should be appreciated that the present invention can be implemented in numerous ways, including as an apparatus, a system, a device, or a method. Several inventive embodiments of the present invention are described below.

[0008] In accordance with one embodiment of the present invention, an apparatus for use in a chemical mechanical planarization (CMP) system is provided. A head capable of being positioned at a proximate location over a polishing pad includes an input and an output defined in the head. The input is capable of delivering a fluid at the proximate location on the surface of a polishing pad. The output being oriented adjacent to the input is capable of removing at least part of the fluid delivered onto the surface of the polishing pad.

[0009] In another embodiment, a method for controlling properties of a film over a polishing pad surface is provided. The method includes delivering a fluid over the polishing pad and removing at least part of the fluid from over the polishing pad surface. The fluid is delivered at a proximate location over the polishing pad surface. The removing of at least part of the fluid is configured to occur at a proximate location over the polishing pad surface and adjacent to the delivery of the fluid.

[0010] In another embodiment, an apparatus capable of controlling a chemical mechanical polishing (CMP) system is provided. The apparatus includes a sensor, a computer, and a head. The head is capable of being positioned at a proximate location over a polishing pad. The head includes an input defined in the head, the input capable of delivering a fluid at the proximate location and onto the surface of a polishing pad, and an output in the

head, the output being oriented adjacent to the input. The output is capable of removing at least part of the fluid delivered onto the surface of the polishing pad..

[0011] In accordance with another embodiment, an apparatus for use in a chemical mechanical planarization (CMP) system is provided. The apparatus includes a head capable of being positioned at a proximate location over a polishing pad. An output defined in the head is capable of being positioned at the proximate location over the polishing pad and is configured to enable removal of a material present on the surface of the polishing pad. An input defined in the head is capable of being positioned at the proximate location over the polishing head, is capable of delivering a fluid to the surface of the polishing pad to at least partially replace the material that is configured to be removed by the output, the output being positioned on the head adjacent to the input.

[0012] It is to be understood that the foregoing general description and the following detailed description are exemplary and explanatory only and are not restrictive of the invention, as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] The accompanying drawings, which are incorporated in and constitute part of this specification, illustrate exemplary embodiments of the invention and together with the description serve to explain the principles of the invention.

[0014] Figure 1 is a cross-sectional diagram of a chemical mechanical planarization (CMP) system used for the differential closed loop planarization control, in accordance with one embodiment of the present invention.

[0015] Figure 2 is a top view diagram of a differential control loop chemical mechanical planarization (CMP) system showing a single head with several inputs and outputs, in accordance with one embodiment of the present invention.

[0016] Figure 3 is a top view diagram of a differential control loop chemical mechanical planarization (CMP) system showing a head that can slide on an arm, in accordance with one embodiment of the present invention.

[0017] Figure 4 is a top view diagram of a differential control loop chemical mechanical planarization (CMP) system showing a head that can be moved by an extending arm, in accordance with one embodiment of the present invention.

[0018] Figure 5A is side view of an alternate configuration, in accordance with one embodiment of the present invention.

[0019] Figure 5B is top view of the present invention employed in a rotary type system, in accordance with one embodiment of the present invention.

[0020] Figure 6 is a flow chart of a method for controlling properties of a film over a polishing pad surface, in accordance with one embodiment of the present invention.

[0021] Figure 7 is a flow chart of a method for providing differential control for removal rates applied to a substrate surface through a removal of slurry from the polishing pad, in accordance with one embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0022] Several exemplary embodiments of the invention will now be described in detail with reference to the accompanying drawings. In the following description, numerous specific details are set forth in order to provide a thorough understanding of the present invention. It will be understood, however, to one skilled in the art, that the present invention may be practiced without some or all of these specific details. In other instances, well known process operations have not been described in detail in order not to unnecessarily obscure the present invention.

[0023] Figure 1 is a schematic diagram of a chemical mechanical planarization system capable of providing real time differential closed loop control in accordance with one embodiment of the invention. A wafer 130 held by a wafer carrier 135 is rotated against polishing pad 101. A fluid delivery device 103 delivers a first fluid 102 to polishing pad 101. The first fluid 102 typically contains a slurry intended for chemical mechanical planarization of a wafer 130 that consists of both chemical and physical abrasives which affect removal of material on the surface of a wafer. Slurry on the polishing pad 101 may be joined by other particulates, abrasives, material residues, pad residues, de-ionized water, and isopropyl alcohol already resident on the polishing pad 101 all of which combine to form a film across the surface of the polishing pad 101. Grooves 106 and micropores 108 in the polishing pad 101 transport the first fluid 102 in the direction 120 of the wafer carrier 135. It should be appreciated that any suitable technique may be used to deliver fluid to the polishing pad 101 such as pump, air pressure, etc.

[0024] A fluid restraining device 104, also referred to as a dam, located downstream from the delivery device, is forced against polishing pad 101 to evenly distribute the first fluid 102 over the surface of the polishing pad 101. Even distribution entails uniform

disbursement of slurry across the width of the polishing pad 101, creating a uniform film that proceeds in the direction of the wafer. The delivery device 103, therefore does not have to be an instrument requiring precise distribution of the first fluid 102 to the polishing pad 101. The fluid flow restraining device 104 presses against polishing pad 101 creating a pool of the first fluid 102 upstream from the fluid restraining device 104. It will be apparent to one skilled in the art that fluid restraining device 104 may be clipped or affixed by other suitable technique to an arm extending over polishing pad 101. The arm extending over polishing pad 101 may be manipulated in a vertical as well as a horizontal direction in order to control the angle and gap, relative to polishing pad 101. In one embodiment, fluid restraining device 104 is composed of the same material of polishing pad 101, i.e., polyurethane. It should be appreciated, however, that fluid restraining device 104 may be constructed from any material which is compatible with the CMP operation and is capable of creating a pool of the first fluid 102 while providing for the even distribution downstream.

[0025] Still referring to Figure 1, a head 115 is located between the fluid restraining device 104 and the wafer carrier 135. The location of the head 115 over the polishing pad 101 may be between about 0.1 mm and about 1 mm and will be optimized to provide best execution response. The exact optimal position will depend on the first fluid 102 dispensing rate, its viscosity, wetting coefficient, and other parameters defining the efficiency of the head 155 in replacing the first fluid 102 with a second fluid 118. The head 115 has at least one input 117 capable of delivering a second fluid 118 and at least one output 119 capable of removing the first fluid 102 and a portion of the second fluid 118 by way of vacuum and other pressurized techniques. Delivery of the second fluid 118 includes even distribution at the desired location on the surface of the polishing pad 101. The second fluid 118 may be one of an abrasive-free chemically inert liquid, deionized

water and other process indifferent fluids. A gap 116 adjacent to the surface of the polishing pad 101 between one of the inputs 117 and one of the outputs 119 of the head 115 allows for the second fluid 118 to dilute and remove the first fluid 102 via the output 119. Dilution of the first fluid 102 slows, and in the limit removal of the first fluid 102, prevents planarization of the wafer 130 by the CMP system. During removal of the first fluid 102, primarily slurry along with other constituents of the film such as particulates, material residues and pad residues, a portion of the second fluid 118, namely de-ionized water, proceeds in the direction 120 of the wafer carrier 135. There is effectively reduced or no planarization of a surface of the wafer 130 when the second fluid 118 is applied to the polishing pad 101.

[0026] As described above, when the polishing pad 101 moves in the direction 120 toward the application area it carries with it a first fluid 102, which may be a film containing material such as slurry, particulates, material residues, and pad residues. In one embodiment a portion of the material remaining on the polishing pad 101, the first fluid 102, is removed prior to the addition of the second fluid 118, which may be one of an abrasive-free chemically inert liquid, deionized water and other process indifferent fluids. Some portion of the second fluid 118 may be removed along with the first fluid 102 through the gap 116 and the output 119 in the head 115. In this manner, the second fluid 118 may assist in the removal of the first fluid 102 by providing a diluting and lifting effect of the first fluid 102 from the surface of the polishing pad 101. In another embodiment, all of the material remaining on the polishing pad 101, the first fluid 102, is removed by the output 119 in the head 115 prior to the application of the second fluid 118 through the input 117. In the case of complete removal or near complete of the first fluid 102 and replacement with the second fluid 118, the second fluid 118, a process indifferent

fluid, proceeds in the direction 120 of the application area providing effectively reduced or no material removal in the specified portion of the wafer 130.

[0027] The wafer carrier 135 is capable of incorporating at least one sensor 140 configured to detect material properties of the wafer and the progress of the CMP operation. In one embodiment, the sensor may detect a signal indicating a film thickness. In the case of conductive films, the plurality of sensors 140 may be inductive sensors configured to detect a signal produced by a magnetic field emitted by the induced current. Frequently, the signal indicating the thickness of the film includes third body effects. Inductive sensors allow for the contactless measuring of a thin conductive (eg. metal) film thickness in the full range of thicknesses normally utilized in semiconductor manufacturing, typically varying from about 0-15,000 Angstroms. It has been determined that inductive sensors are capable of providing a fast enough response for a wafer moving under typical loading robotics velocity. Therefore, it is possible to perform thickness measurements during processing without impacting process throughput. Moreover, the movement of the wafer can be taken advantage of to produce a film thickness profile from a limited number of sensors in a cluster configuration. For example, wafer aligners provide movement in a rotational direction and a linear radial direction to position wafers in a consistent manner. Accordingly in the present invention, a cluster of sensors can capture a film thickness profile of a wafer while the wafer is undergoing common automated wafer handling schemes, or while being rotated during CMP. As the wafer 130 is rotated, a film thickness profile can be generated for the wafer 130 so that the head 115 can optimize slurry displacement for the desired thickness profile.

[0028] Still referring to Figure 1, a computer 150, also referred to as a controller, coordinates the various control activities for the CMP system 100. The computer 150 is capable of communication 142 with the plurality of sensors 140, the head 115, the fluid

restraining device 104 and the fluid delivery device 103. The computer 150 may be configured to adjust the signal indicating the thickness of the film from the sensors 140 to substantially remove both third body effects introduced by the CMP system and a substrate thickness component. According to the value of the adjusted signal, control signals for second fluid 118, the fluid restraining device 104, and fluid delivery device 103 may be generated. Film thickness feedback from the sensors 140 provides the computer 150 information necessary to regulate removal rates via commands issued to the head 115. If the signal generated by any one of sensors 140 indicates that the removal rate is too high, i.e., the thickness is lower in a particular region of wafer 130 corresponding to one of the sensors 140, then the second fluid 118, being either deionized water or some other suitable displacement chemistry may be distributed through the one of the inputs 117 on the head 115 in order adjust the degree of planarization and reduce the removal rate experienced at the corresponding point on wafer 130. Similarly, when a desired thickness on a portion of the wafer 130 has been obtained, the head 115, operating as an execution and correction system, replaces the first fluid 102 with second fluid 118 preventing further planarization in the affected area. As used herein, an execution and correction system receives commands from the computer 150 and performs an operation such as fluid delivery and removal in the present invention. Correction and adjustment of the processing application is provided by the head 115 when slurry is removed at specified locations on the surface of the polishing pad 101.

[0029] Figure 2 provides a top view of the CMP system described above. It should be appreciated that the rotational velocity of wafer 130, along with the linear velocity of polishing pad 101, creates a situation where fluid directed at the center of wafer 130 is pushed off to the side due to the rotational velocity of the wafer 130. In that situation, e.g., where slurry is present on the polishing pad 101, the center of wafer 130 experiences

a lower removal rate due to a lesser amount of slurry being available at the center. The head 115 downstream from the fluid restraining device 104 applies differential removal rates to portions of a surface of wafer 130 by removal of slurry and replacement with water at a plurality of locations designated by the sensors 140. Additionally the rotation of the wafer provides for an alternative path 122 for fluids directed under the wafer carrier 135. The path of fluids delivered on a linear belt will affect a circular application when applied to the wafer in rotation. The inputs 117 capable of providing the second fluid are also capable of being placed in a position according to the anticipated rotation of the wafer 130 in a direction 121.

[0030] In the case of linear belt CMP systems, it should be appreciated that the belt is capable of moving in a linear direction 120 towards the wafer 130 while the wafer 130 is spinning about its axis. Thus, the relative velocity experienced by top section 130a of wafer 130 is greater than the relative velocity experienced by bottom section 130b during a rotation cycle of wafer 130. As a result, the polishing pad 101 tends to stain in the region experiencing the higher relative velocity, due to the greater amount of debris accumulated at the upper half of belt. Thus, one function of the fluid restraining device 104 and the pool of the first fluid 102 is to collect and distribute the debris more uniformly rather than having the debris recycle in the same general area of polishing pad 101. Uniform distribution of the debris may extend the life of the polishing pad 101 by promoting a more uniform wearing pattern.

[0031] As shown in Figure 2, it should be appreciated by those skilled in the art that the fluid may be removed by outputs 119 and a second fluid 118 may be delivered and at one or multiple locations. The locations of the inputs 117 and outputs 119 can be configured on the head 115 enabling isolation of specific regions on the surface of the polishing pad 101 in order to manipulate the removal rate applied to wafer 130. Because a gap 116

adjacent to the surface of the polishing pad 101 between one of the inputs 117 and one of the outputs 119 of the head 115 allows for the second fluid 118 to dilute and remove the first fluid 102 via the output 119, it can be said that the inputs 117 and the outputs 119 are coupled together in pairs. The activation of pairs of the inputs 117 and outputs 119 can be independently controlled by the computer 150 as described in Figure 1 above, so that the computer 150 can isolate removal of the first fluid 102 in designated sections of the polishing pad 101. The head 115 could contain a plurality of inputs 117 and outputs 119 as shown spanning the width of the polishing pad 101. The head 115 could be held by an arm 114 that extends across the width of polishing pad 101 that operate in the fashion described in Figure 1 above. The arm 114 could be supported by an apparatus above the polishing pad 101 or could be supported by other structures on the system by extending beyond the polishing pad 101.

[0032] Figure 3 provides an alternative arrangement of the head 115 configured on the arm 114. The head 115 could move linearly along an arm 114 that extends across the width of polishing pad 101 as illustrated in Figure 3. The location of the head 115 can enable isolation of specific regions on the surface of the polishing pad 101 under the inputs 117 and outputs 119 in order to manipulate the removal rate applied to wafer 130. A plurality of heads 115' may be optional for improved coverage of the application area, the area of the polishing pad 101 that will pass below the surface of the wafer 130. The head 115 and the heads 115' could move linearly in concert or independently along an arm 114 that extends across the width of polishing pad 101. The computer 150, described in Figure 1 above, is capable of providing orchestration of the movement of head 115 or heads 115' in order to properly prepare the polishing pad 101 for the differentially controlled planarization operation.

[0033] Alternatively, as shown in Figure 4, the arm 114 could move the head 115 to locations designated by the sensors 140. The arm 114 may have several joints 113 and may be controlled by any suitable technique such as a step motor, servo motor, etc., in order to direct slurry, deionized water, or some other suitable fluid on the surface of polishing pad 101 downstream from fluid restraining device 104, in order to manipulate the removal rate applied to wafer 130. Additionally a plurality of arms 114' could move a plurality of heads 115' to locations designated by the computer 150 as described in Figure 1 for polishing pad 101 preparation.

[0034] Figure 6 is a flow chart of a method for controlling properties of a film over a polishing pad in accordance with one embodiment of the invention. The method begins by delivering a fluid over the polishing pad at a proximate location over the polishing pad surface in operation 404. In operation 408, at least part of the fluid from over the polishing pad surface is removed at a proximate location over the polishing pad surface adjacent to the delivery of the fluid. The removal of fluid from the film over the polishing pad surface can assist in controlling properties of the film. The film may include slurry, an amount of de-ionized water, an amount of chemicals, isopropyl alcohol, particulates, abrasives, material residues, and pad residues. The composition of the film on the polishing pad has a direct effect on the planarization performed on the surface of the wafer. Removing slurry from the film prevents planarization at a proximate location on the polishing pad surface.

[0035] Figure 7 is a flow chart diagram illustrating an operational method for providing differential control of removal rates applied to the surface of a wafer in accordance with one embodiment of the invention. The method begins when a wafer is provided for the purpose of having a film or films removed in operation 504. A thickness map of the substrate could be generated prior to a processing operation. The thickness map may be

generated as the surface of a wafer is scanned to obtain thickness data in the absence of third bodies. Here, an aligner and other transfer stations may be used to scan the surface of the wafer in order to create a thickness map as described above. Third bodies, i.e., conductive objects are not present here as only the wafer and the scanning mechanism is used to create the thickness map. A substrate component of the thickness data and a film component of the thickness data is identified. Here, the signal generated by scanning the surface of the wafer is subdivided into the substrate component and a film component. For example, an inductive signal may be broken down into the two components. It should be appreciated that from this component data, calibration coefficients may be generated which may be subsequently applied to a downstream measurement of the thickness, i.e., a sensor embedded in a wafer carrier, in order to more precisely determine the thickness.

[0036] The method then proceeds to operation 506 where the wafer is transferred to a processing station. In one embodiment, the processing station is a CMP system. Of course, any suitable robotic, mechanical, or manual technique may be used to transfer the wafer to the processing station. The method then moves to operation 508 where sensors on the wafer carrier determine film thickness corresponding to discrete points on the wafer and the presence of third bodies is detected. Here, one or more sensors embedded in the wafer carrier as described above with reference to Figures 1-4 may be used to detect the thickness data. In one embodiment, an inductive sensor is used for this detection, however scatterometers, spectral reflectometry, thermal monitoring, stress monitoring, and other sensors could be employed.

[0037] Next in operation 510, thickness data corresponding to the point on the wafer is adjusted to substantially eliminate both the substrate component and the third body effects. That is, the calibration coefficient determined in the absence of third bodies is used to isolate the thickness data related to the film on the wafer described above. A coordinate

of the thickness map is associated with a sensor (eg. inductive sensor described above) utilized in the processing operation. A point on the thickness map may be associated with a sensor embedded in the wafer carrier so that the planarization process may be controlled in the region associated with the sensor embedded in the wafer carrier. A computer, also known as a controller, as described in Figure 1 above may provide the calculations necessary to make this association. When slurry is applied to the pad in operation 512, planarization of the wafer surface begins in operation 514. Film thickness at discrete locations is calculated by the computer based on feedback from the sensors 516 as describe above. Until desired thickness is obtained at a particular location in operation 518, the planarization process continues per operation 521. If the desired thickness is obtained a particular location a query of all sensor locations is made in operation 522. If desired thickness is obtained at some but not all locations, a head removes slurry from regions having desired thickness or excessive removal rates and substitutes a second chemically inert non-abrasive fluid in operation 525 as described in Figures 1-4 above. The method then continues to apply slurry to the polishing pad in operation 512 while areas designated by the computer as having obtained the desired thickness have the second fluid substituted for slurry. Operation 512 continues until sensors at all locations indicate that the desired thickness has been obtained in operation 522. When desired thickness has been obtained at all positions on the wafer, the planarization process is complete and the wafer is removed from the polishing pad in operation 530.

[0038] In summary, the present invention provides for a CMP system that capable of being configured to differentially control removal rates being applied to regions of a wafer. Differential control enables for a uniform thickness to be obtained as opposed to a uniform removal rate. Through the use of a fluid restraining device that creates a pool, a uniform slurry layer is defined downstream of the restraining device. A head, operating as

an execution and control system provides process control by removing abrasives at designated locations in order to arrive at a substrate having a uniform film thickness. The uniform slurry layer provided by the fluid restraining device is removed in areas where a desired film thickness has been obtained as described above. After a desired thickness is detected uniformly about the wafer, the planarization operation is complete and a signal may be issued to stop the operation. The plurality of sensors described above allow for the determination of the endpoint and associated removal rates by initially determining a thickness of a film on the wafer under non-process conditions and also during the planarization process. The determined thickness may be provided to sensors associated with the process operation in order to calibrate the sensor so that variables from processing conditions that cause error in the thickness measurement (third body effects) are substantially eliminated. For example, a calibration coefficient determined under non-process conditions, i.e., without third bodies in the detection region, may be applied to the signal of the second sensor in order to substantially eliminate the third body effects introduced by the processing module. In addition, a thickness map of the wafer is generated where the thickness map breaks down the data into a film thickness component and a substrate component, in order to isolate the film thickness component. As mentioned above, the thickness map is determined under non process conditions. Furthermore, the above described embodiments may be applied to rotary or orbital type CMP systems as well as linear CMP systems that rely upon belt type polishing media.

[0039] The invention has been described herein in terms of several exemplary embodiments. Other embodiments of the invention will be apparent to those skilled in the art from consideration of the specification and practice of the invention. The embodiments and preferred features described above should be considered exemplary, with the invention being defined by the appended claims.

What is claimed is: